FINAL REPORT
SEPTEMBER 2000

REPORT NO. 99-08

JAVELIN MISSILE, LOW-COST ROUND SHIPPING AND STORAGE CONTAINER TP-94-01, TRANSPORTABILITY TESTING PROCEDURES

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REPORT NO. 99-08 **September 2000**
JAVELIN MISSILE, LOW-COST ROUND
SHIPPING AND STORAGE CONTAINER
TP-94-01, "TRANSPORTABILITY TESTING PROCEDURES,"
AND MIL-STD-1660, "DESIGN CRITERIA FOR UNIT LOADS,"
TESTING PROCEDURES

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked by Raytheon/Lockheed Martin JAVELIN Joint Venture Program Office to conduct TP-94-01, "Transportability Testing Procedures" and MIL-STD-1660, "Design Criteria for Unit Loads, 8 April 1977" testing on the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers. The testing and evaluation were performed in accordance with TP-94-01 and MIL-STD-1660 testing procedures. Following completion of testing the containers were examined and no damage or major problems were found with the containers. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers have satisfactorily completed the TP-94-01 and MIL-STD-1660 testing requirements.

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REPORT NO. 99-08

JAVELIN MISSILE, LOW-COST ROUND
SHIPPING AND STORAGE CONTAINER
TP-94-01, TRANSPORTABILITY TESTING PROCEDURES

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SECTION A – TRANSPORTABILITY TEST

PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked by Raytheon/Lockheed Martin JAVELIN Joint Venture Program Office to conduct TP-94-01, "Transportability Testing Procedures" on the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded in a boxcar. The containers were tested to the criteria specified in Transportability Testing Procedures, TP-94-01, dated July 1994.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations and Support Command (Prov), Rock Island, IL. Reference is made to the following:

1. Change 6, AR 740-1, 18 August 1976, Storage and Supply Activity Operation.

2. IOC-R, 10-23, Mission and Major Functions of USADAC, 7 January 1998.

C. OBJECTIVE. The objective of the tests was to determine if the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers produced by Raytheon/Lockheed Martin could satisfy the testing requirements of TP-94-01, "Transportability Testing Procedures.

D. CONCLUSION. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers were evaluated in accordance with TP 94-01, "Transportability Testing Procedures." Following the completion of each test, the containers were examined for damage. Final inspection of the containers revealed that no damage had occurred during testing.

E. <u>RECOMMENDATION</u>. As a result of the performance of the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers during testing, the JAVELIN missile container has satisfactorily completed the testing requirements of TP-94-01, "Transportability Testing Procedures."

PART 2 - ATTENDEES

DATES PERFORMED: 7-9 December 1999

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PART 3 - TEST PROCEDURES

The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," July 1994, for validating tactical vehicles and outloading procedures used for shipping munitions by intermodal freight containers, commercial or tactical truck, or trailer or railcar. The rail impact test procedure is described below.

A. TEST PREPARATION: The test load was prepared using the blocking and bracing procedures proposed for use with munitions (see part 6 for procedures). The first rail impact test was conducted with the JAVELIN Missile, Low Cost Round, Shipping and Storage Containers test load in the 50-foot boxcar in the crosswise direction. The second rail impact test was conducted with the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers test load in the boxcar in the lengthwise direction. Inert (non-explosive) items were used to build the load. The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers test load were identical to live (explosive) ammunition. Inert (non-explosive) items were used as ballast to equate the payload weight to that of a fully loaded boxcar of JAVELIN Missile, Low-Cost Round Shipping and Storage Containers.

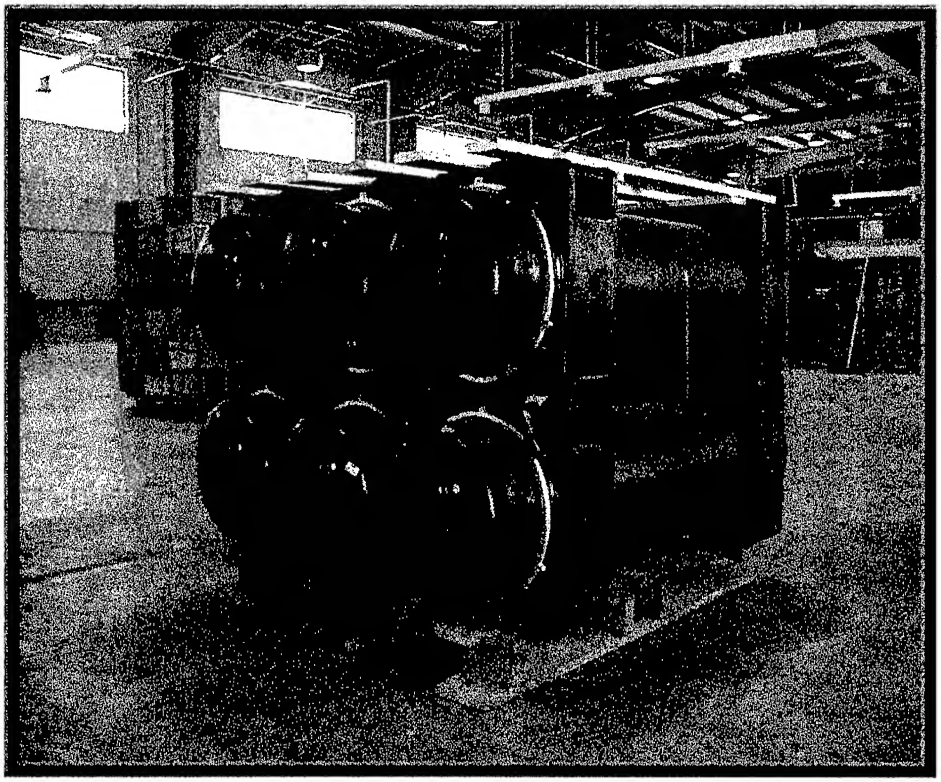

Photo 1. **Single Pallet of JAVELIN Missile, Low-Cost Round Shipping and Storage Containers**

B. RAIL IMPACT TEST METHOD. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers were loaded and secured in the conventional friction draft gear boxcar. Equipment needed to perform the test included the specimen (hammer) car, four (4) empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars were positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit pushed the specimen car toward the anvil at a predetermined speed, then disconnected from the specimen car approximately fifty (50) yards away from the anvil cars allowing the specimen car to roll freely along the track until it struck the anvil. This constituted an impact. Impacting was accomplished at speeds of 4, 6, and 8.1 mph in one direction, and at a speed of 8.1 mph in the reverse direction. The 4 and 6 mph impact speeds were approximate; the 8.1 mph is a minimum. Impact speeds were determined by using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).

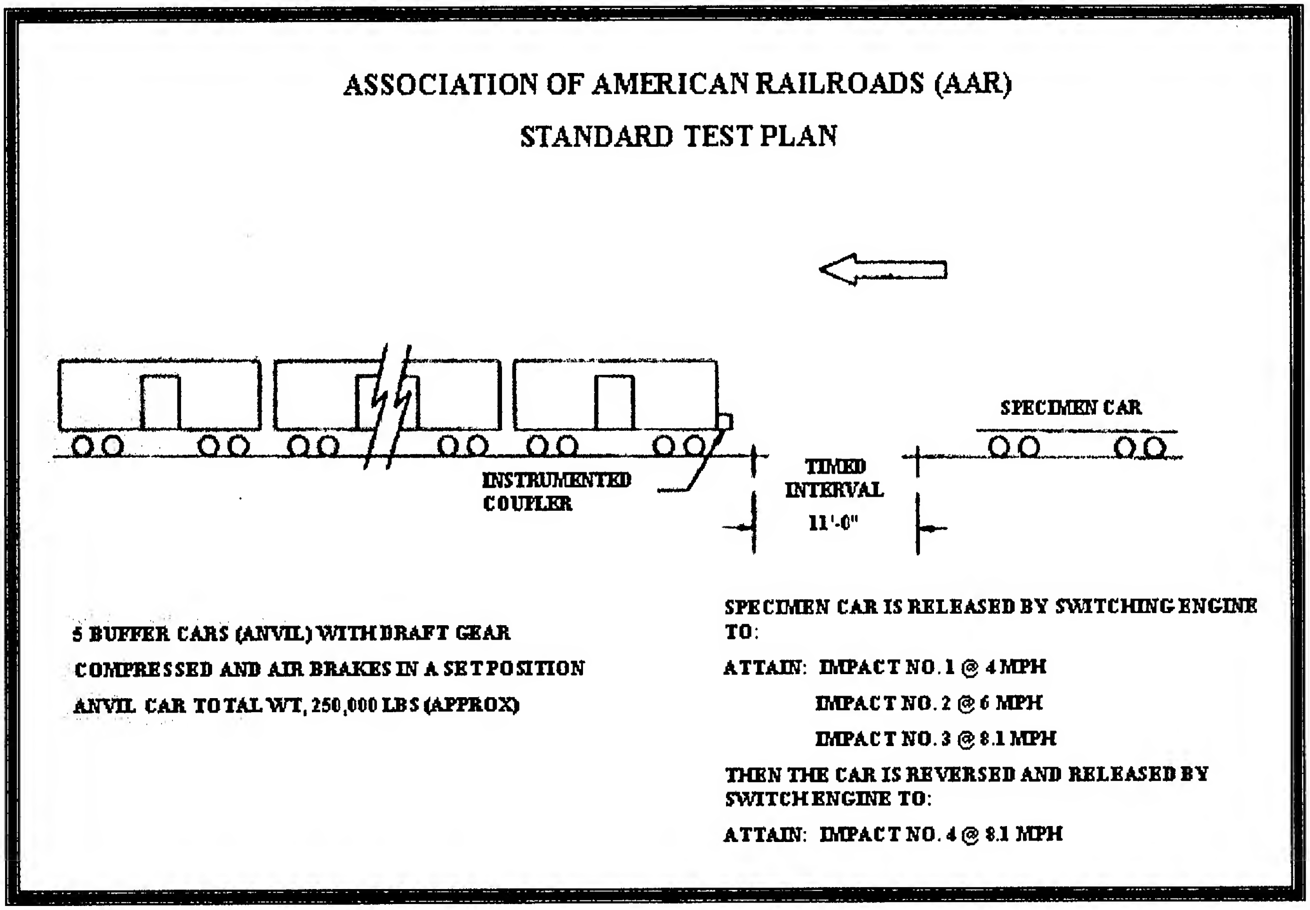

Figure 1.

C. HAZARD COURSE. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers were loaded and secured in a 20-foot intermodal freight container and transported over the 200-foot-long segment of concrete-paved road that consists of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course was traversed two times (see figure 2).

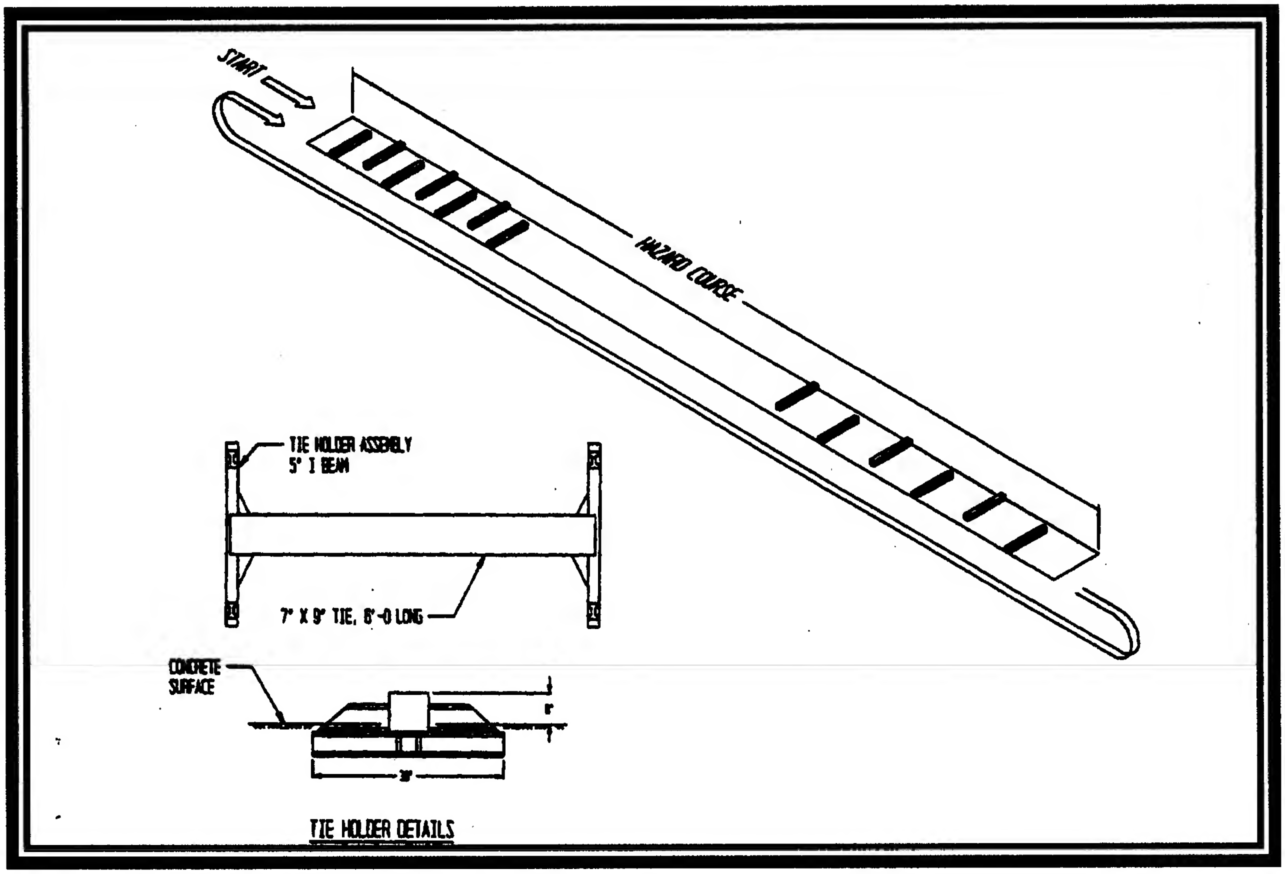

Figure 2.

1. The first series of ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

2. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.

3. The second series of ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

4. The test load is driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

D. ROAD TRIP. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers in the 20-foot intermodal freight container and were transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route included curves, corners, railroad crossings, and stops and starts. The test load traveled at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

E. PANIC STOPS. Testing was not required due to the previously conducted rail impact test.

F. WASHBOARD COURSE. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers in the 20-foot intermodal freight container were driven over the washboard course (see Figure 3. below) at a speed that produced the most violent response in the test load.

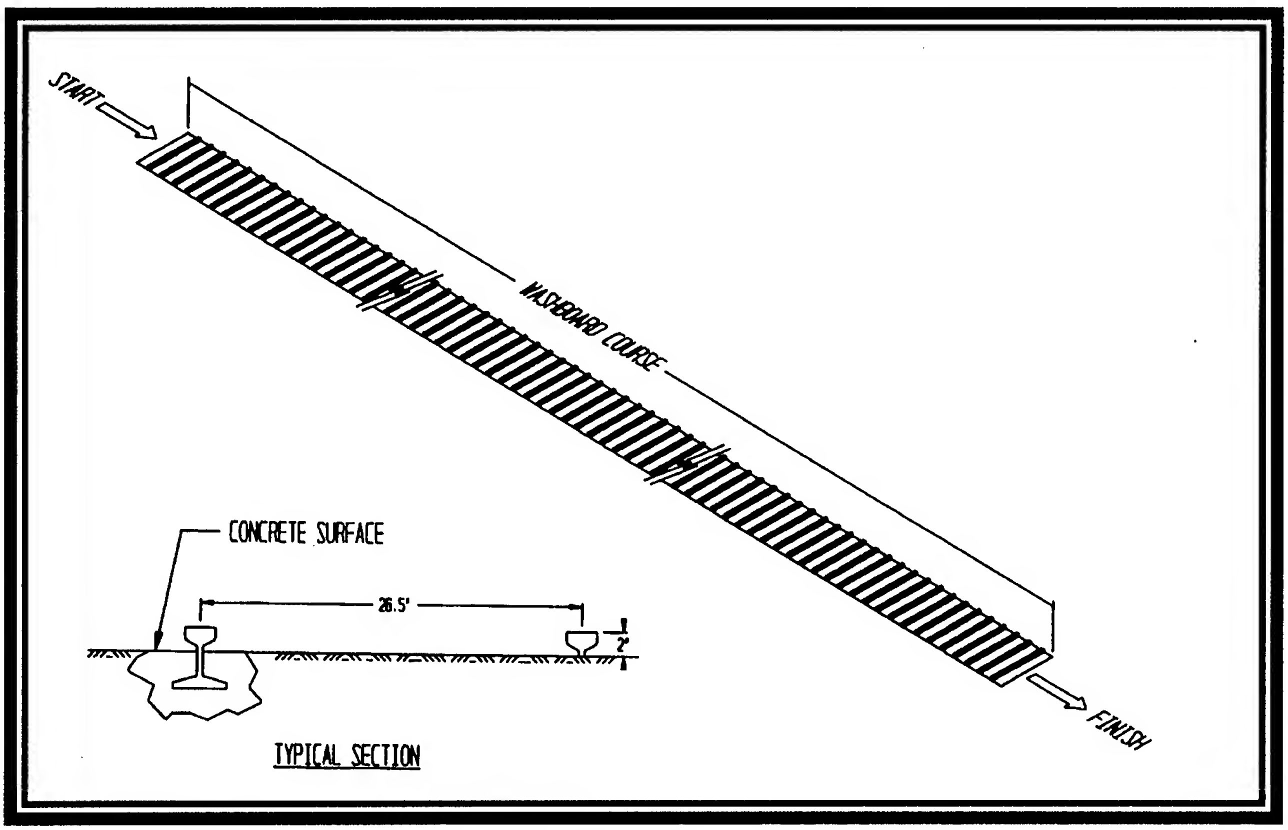

Figure 3.

G. <u>SHIPBOARD TRANSPORTATION SIMULATOR (STS)</u>. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers in the 20-foot intermodal freight container are positioned onto the STS and locked into place using the cam lock at each corner. Oscillation of the STS is initiated at an angle of 30 degrees (+, - 2 degrees) either side of center and at a frequency of 2 cycles per minute (30 seconds plus or minus 2 seconds total roll period). This frequency is observed for apparent and initial defects that could cause a safety hazard. Once the test load is determined to be safe the frequency of oscillation is increased to 4 cycles per minute (15 seconds plus or minus 1 second roll period) and the STS is operated for 2 hours. If inspection of the load does not indicate an impending failure, the frequency of oscillation is increased to 5 cycles per minute (12 seconds plus or minus 1 second roll period), and the STS is operated for 4 hours. STS operation does not have to be continuous, however, no change or adjustments to the load or restraints is permitted at any time during the test. After being set in place the test load shall not be removed from the apparatus until the test has been completed or terminated.

PART 4 - TEST RESULTS

RAIL IMPACT TEST DATA

Test Number 1

Date: 5 May 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded in a 20-foot intermodal freight container.

Impact Number	Velocity (mph)	Remarks
1	4.46	None
2	6.52	None
3	8.10	None
4	8.72	None

Notes:

1. Following each impact the JAVELIN containers were inspected and no damage was found.
2. Maximum load gap was 1.25 inches.

Test No. 2

Date: 7 December 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers Loaded Crosswise in the boxcar.

DESCRIPTION	WEIGHT
Boxcar Number: 27500	64,900 lbs.
JAVELIN Containers Wt.	5,760 lbs.
Ballast:	
105MM boxed ammunition	39,200 lbs.
120MM tank ammunition	1,500 lbs.
Total Specimen Wt.	111,360 lbs.
Buffer Car (four cars)	250,000 lbs.

Impact Number	Velocity (mph)	Remarks
1	4.39	105MM dunnage broke
2	6.56	105MM moved
3	8.36	105MM moved
4	8.62	None

Notes:

1. The 105MM boxed ammunition moved during testing due to breakage of the blocking and bracing. Following impact number 3 the determination was made that the blocking and bracing being used on the 105MM had been damaged to such an extent that replacement was required prior to impact number 4 due to safety reasons. The 105MM ammunition was being used as ballast and does not have any impact on the results of the JAVELIN testing.
2. Following each impact the JAVELIN containers were inspected and no damage was found.

Photo 2. Rail Impact Test of Palletized JAVELIN Missile, Low-Cost Round Shipping and Storage Containers Loaded Crosswise in the Boxcar

Test Number 3.

Date: 9 December 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded lengthwise in the boxcar.

Description	Weight
Boxcar Number: 27500	64,900 lbs.
JAVELIN Containers Wt	5,760 lbs.
Ballast:	
105MM boxed ammunition	39,200 lbs.
Total Specimen Wt.	109,860 lbs.
Buffer Car (four cars)	250,000 lbs.

Impact Number	Velocity (mph)	Remarks
1	4.52	Load compacted 1-2 inches
2	6.00	Load compacted 2-4 inches
3	8.62	Load compacted 5 inches
4	8.52	Load returned to original

Notes:

Following each impact the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers were inspected and no damage was found.

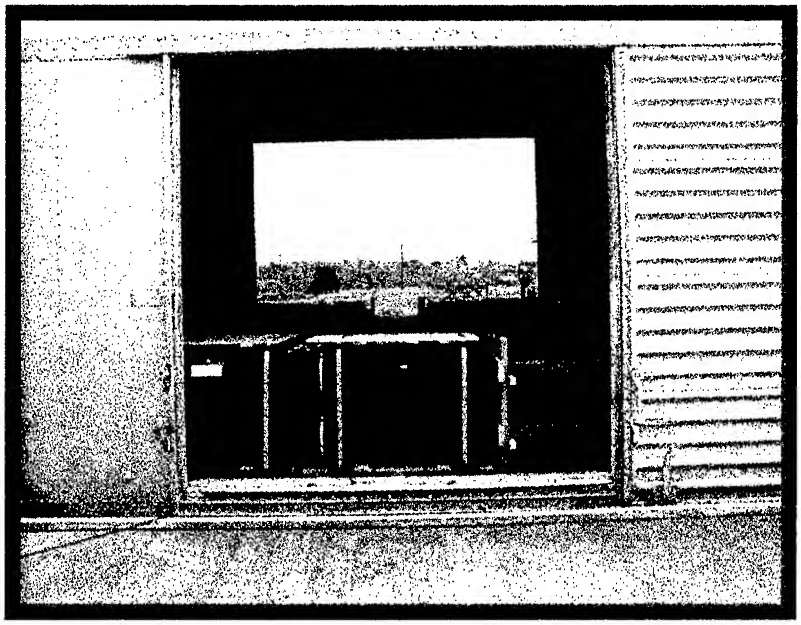

Photo 3. **Rail Impact Test of Palletized JAVELIN Missile, Low-Cost Round Shipping and Storage Containers Loaded Lengthwise in the Boxcar**

Photo 4. **Rail Impact Test of Palletized JAVELIN Missile, Low-Cost Round Shipping and Storage Containers Loaded Lengthwise in the Boxcar**

Photo 5. **Movement of Load Following Rail Impact Test with JAVELIN Missile, Low-Cost Round Shipping and Storage Containers Loaded Lengthwise in the Boxcar**

B. HAZARD COURSE.

Test Date: 5 May 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded in a 20-foot intermodal freight container.

Pass No.	Elapsed Time	Velocity (mph)
1	34	4.0
2	38	3.6
3	35	3.9
4	30	4.5

Remarks: No damage occurred during testing.

C. ROAD TRIP.

Test Date: 5 May 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded in a 20-foot intermodal freight container.

Remarks: No damage occurred during testing.

D. WASHBOARD COURSE.

Test Date: 5 May 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded in a 20-foot intermodal freight container.

Remarks: No damage occurred during testing.

E. SHIPBOARD TRANSPORTATION SIMULATOR (STS).

Test Date: 6 May 1999

Specimen Load: JAVELIN Missile, Low-Cost Round Shipping and Storage Containers loaded in a 20-foot intermodal freight container.

Remarks: No damage occurred during testing.

PART 5 – DRAWINGS

TEST PLANS FOR LOADING BOXCARS WITH JAVELIN PLASTIC CONTAINER PALLET UNITS*

* BALLAST PALLET UNITS USED FOR THESE PROCEDURES INCLUDE PA116 CONTAINERS PALLETIZED IAW AMC DRAWING 19-48-4079/7B-20PM1002, USED WITHIN THE JAVELIN PALLET UNITS (PALLETIZED IAW 19-48-5266A-GM20JV1), AND 105MM CARTRIDGE BOXES, PALLETIZED IAW AMC DRAWING 19-48-4116/45-20PA1002, EXCEPT THAT IT IS LOADED ON A 40" X 48" PALLET, INSTEAD OF A 35" X 45-1/2" PALLET, USED ONLY FOR ADDED WEIGHT WITHIN THE BOXCAR.

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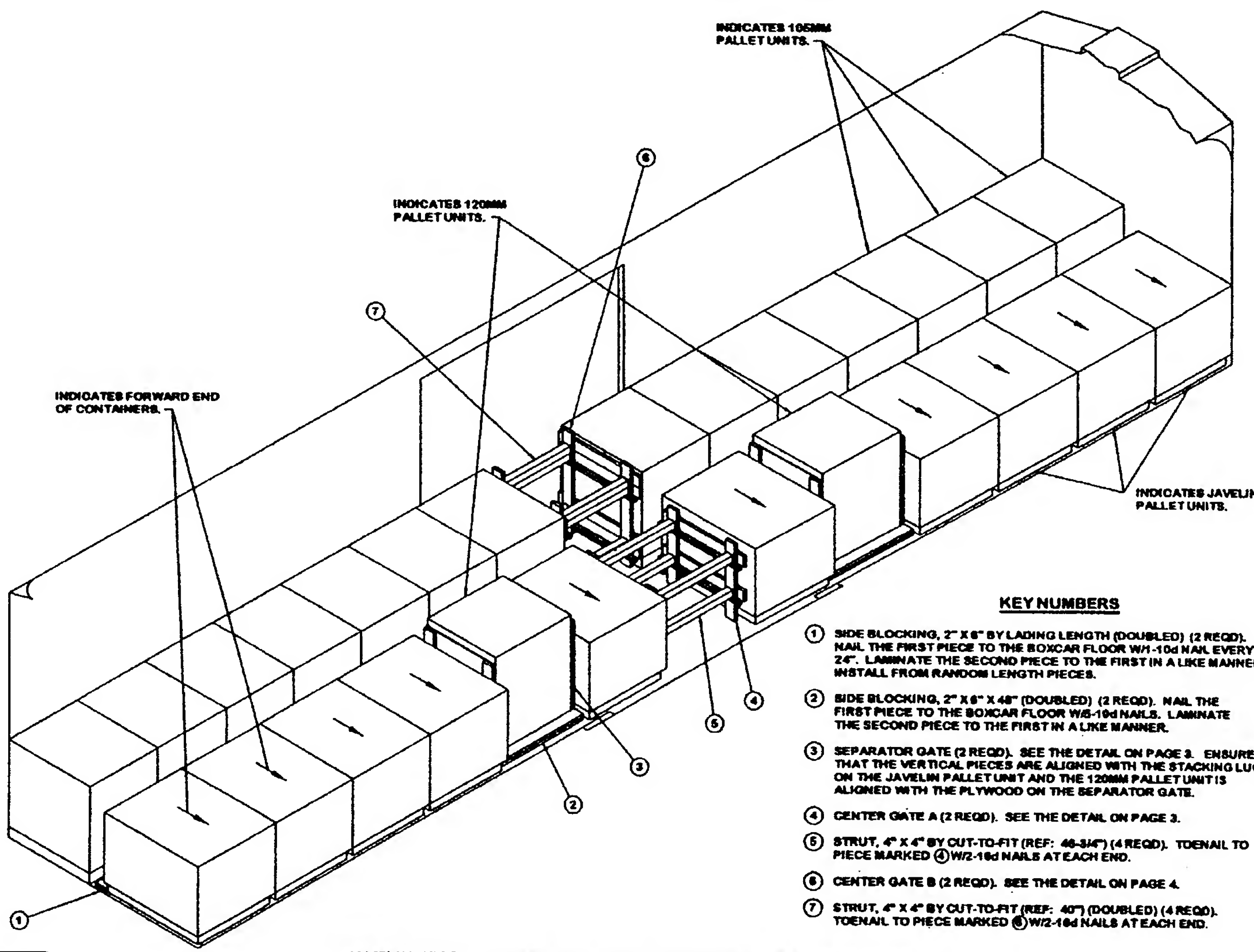
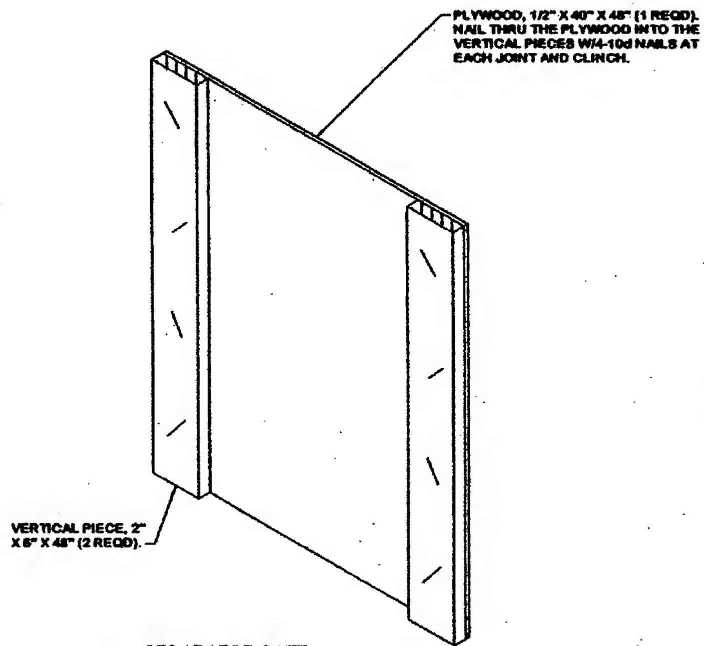


KEY NUMBERS

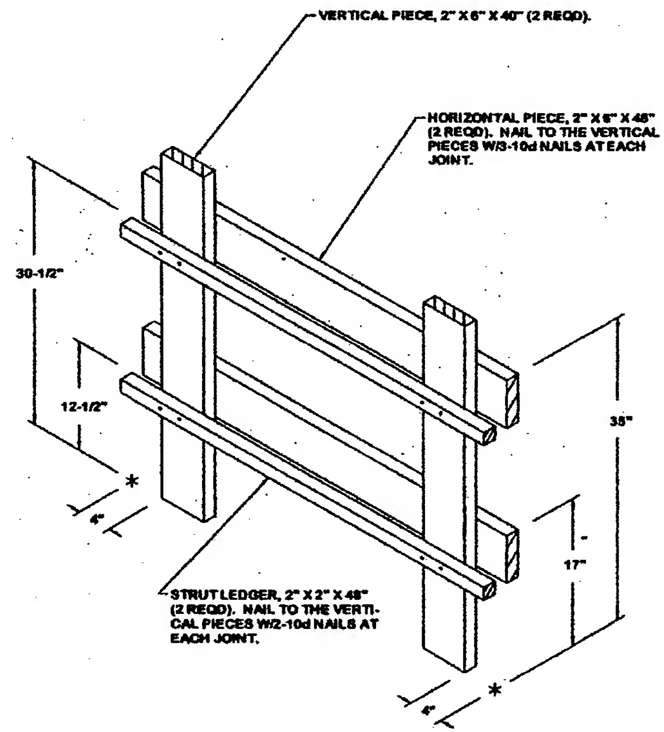
1. SIDE BLOCKING, 2" X 6" BY LADING LENGTH (DOUBLED) (2 REQD). NAIL THE FIRST PIECE TO THE BOXCAR FLOOR W/1-10d NAIL EVERY 24". LAMINATE THE SECOND PIECE TO THE FIRST IN A LIKE MANNER. INSTALL FROM RANDOM LENGTH PIECES.
2. SIDE BLOCKING, 2" X 6" X 48" (DOUBLED) (2 REQD). NAIL THE FIRST PIECE TO THE BOXCAR FLOOR W/5-10d NAILS. LAMINATE THE SECOND PIECE TO THE FIRST IN A LIKE MANNER.
3. SEPARATOR GATE (2 REQD). SEE THE DETAIL ON PAGE 3. ENSURE THAT THE VERTICAL PIECES ARE ALIGNED WITH THE STACKING LUGS ON THE JAVELIN PALLET UNIT AND THE 120MM PALLET UNIT IS ALIGNED WITH THE PLYWOOD ON THE SEPARATOR GATE.
4. CENTER GATE A (2 REQD). SEE THE DETAIL ON PAGE 3.
5. STRUT, 4" X 4" BY CUT-TO-FIT (REF: 46-3/4") (4 REQD). TOENAIL TO PIECE MARKED 4 W/2-16d NAILS AT EACH END.
6. CENTER GATE B (2 REQD). SEE THE DETAIL ON PAGE 4.
7. STRUT, 4" X 4" BY CUT-TO-FIT (REF: 40") (DOUBLED) (4 REQD). TOENAIL TO PIECE MARKED 6 W/2-16d NAILS AT EACH END.

JAVELIN TEST 1 - LOADED WITH CONTAINERS CROSSWISE IN BOXCAR



SEPARATOR GATE

ALIGN THE VERTICAL PIECES WITH THE STACKING LUGS ON THE JAVELIN PALLET UNIT. CENTER THE 120MM PALLET UNIT ON THE PLYWOOD.

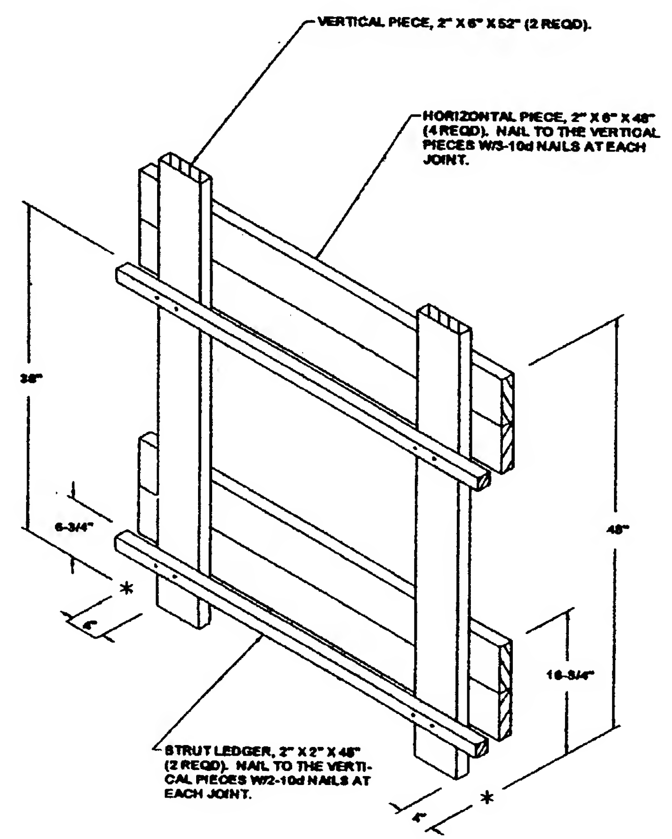


CENTER GATE A

(FOR USE WITH THE CROSSWISE JAVELIN PALLET UNITS)

PAGE 3

JAVELIN TEST 1 - LOADED WITH CONTAINERS CROSSWISE IN BOXCAR - DETAILS

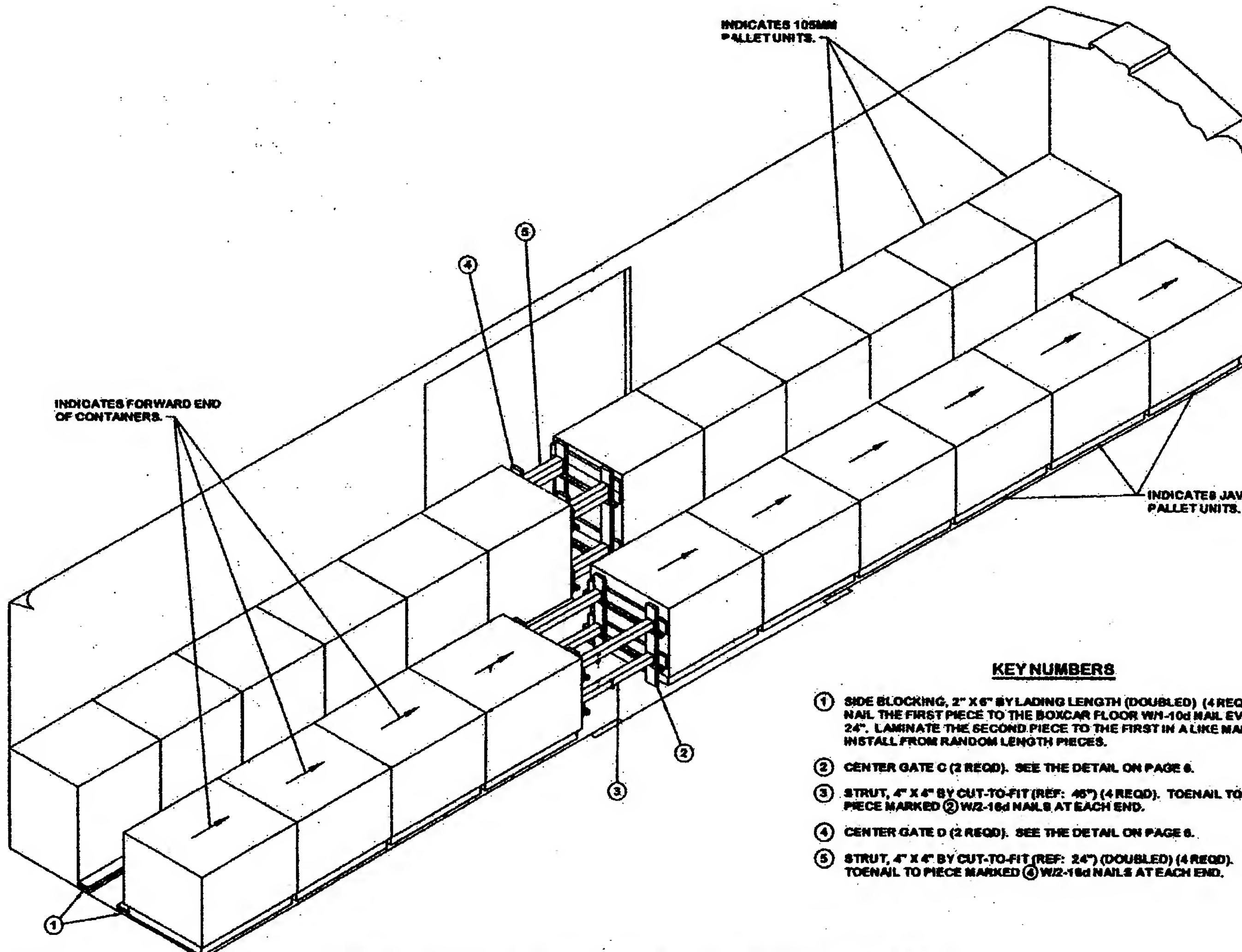


CENTER GATE B

(FOR USE WITH THE CROSSWISE 10[illegible]MM PALLET UNITS)

PAGE 4

JAVELIN TEST 1 - LOADED WITH CONTAINERS CROSSWISE IN BOXCAR - DETAILS

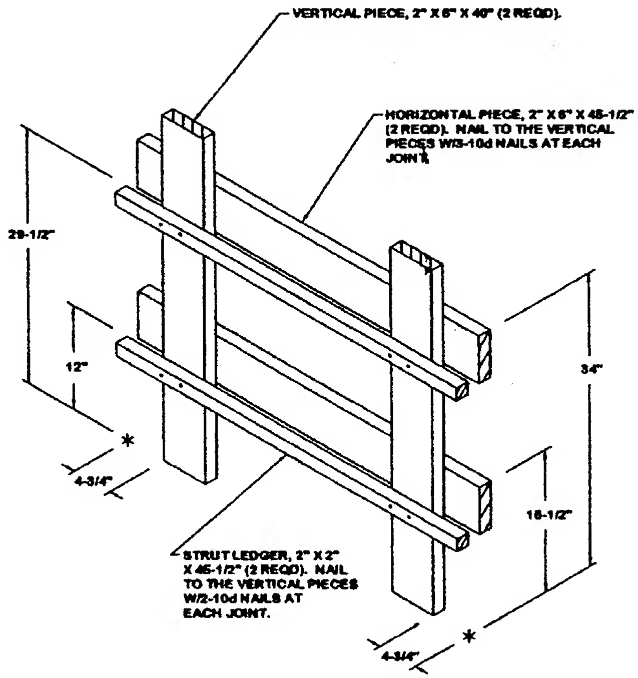


KEY NUMBERS

1. SIDE BLOCKING, 2" X 6" BY LADING LENGTH (DOUBLED) (4 REQD). NAIL THE FIRST PIECE TO THE BOXCAR FLOOR W/1-10d NAIL EVERY 24". LAMINATE THE SECOND PIECE TO THE FIRST IN A LIKE MANNER. INSTALL FROM RANDOM LENGTH PIECES.
2. CENTER GATE C (2 REQD). SEE THE DETAIL ON PAGE 6.
3. STRUT, 4" X 4" BY CUT-TO-FIT (REF: 46") (4 REQD). TOENAIL TO PIECE MARKED 2 W/2-16d NAILS AT EACH END.
4. CENTER GATE D (2 REQD). SEE THE DETAIL ON PAGE 6.
5. STRUT, 4" X 4" BY CUT-TO-FIT (REF: 24") (DOUBLED) (4 REQD). TOENAIL TO PIECE MARKED 4 W/2-16d NAILS AT EACH END.

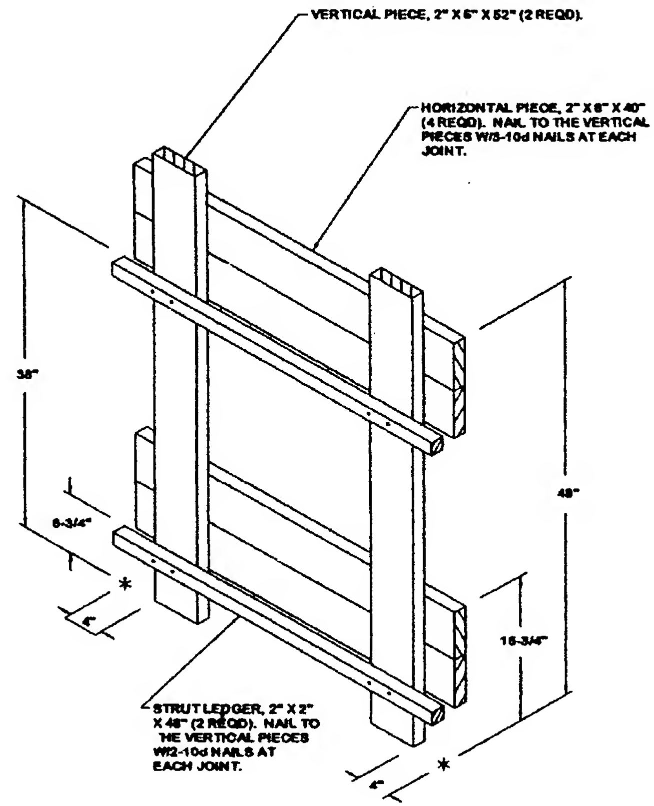
PAGE 5

JAVELIN TEST 2 - LOADED WITH CONTAINERS LENGTHWISE IN BOXCAR



CENTER GATE C

(FOR USE WITH THE LENGTHWISE JAVELIN PALLET UNITS)



CENTER GATE D

(FOR USE WITH THE LENGTHWISE 105MM PALLET UNITS)

PAGE 6

JAVELIN TEST 2 - LOADED WITH CONTAINERS LENGTHWISE IN BOXCAR - DETAILS

SECTION B – MIL-STD-1660

PART 6 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked by Raytheon/Lockheed Martin JAVELIN Joint Venture Program Office to conduct MIL-STD-1660 on the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers. The containers were tested to the criteria specified in MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations and Support Command (Prov), Rock Island, IL. Reference is made to the following:

1. Change 6, AR 740-1, 18 August 1976, Storage and Supply Activity Operation.

3. IOC-R, 10-23, Mission and Major Functions of USADAC, 7 January 1998.

C. OBJECTIVE. The objective of the tests was to determine if the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers met MIL-STD-1660 test requirements.

D. CONCLUSION. The JAVELIN Missile, Low-Cost Round Shipping and Storage Containers were evaluated using MIL-STD-1660 test requirements. As a result of the performance of the JAVELIN Missile, Low-Cost Round Shipping and Storage Containers during testing, the JAVELIN missile container has satisfactorily completed the MIL-STD-1660 testing requirements.

PART 7 - ATTENDEES

ATTENDEE	MAILING ADDRESS
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PART 8 - TEST PROCEDURES

The test procedures outlined in this section were extracted from the MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies the steps that a unitized load must undergo if it is to be considered acceptable. The containers were to undergo tests at ambient temperature and, due to the environmental conditions that it could be subjected to, the containers were tested at extreme temperatures where applicable. The tests that were conducted on the test containers are summarized below.

A. **STACKING TEST**. The unit load was tested to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load was simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. The compression load was calculated in the following manner. The unit load weight was divided by the unit load height in inches and multiplied by 192. The resulting number was the equivalent compressive force of a 16-foot-high load. This test was conducted at ambient temperature and at –51 degrees Fahrenheit to simulate cold storage stacking. Figure 1 below shows an example of a unit load in the compression tester.

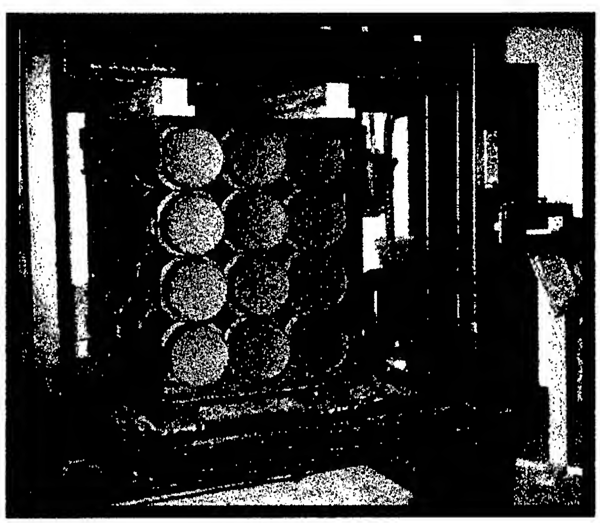

Figure 1. Example of Compression Tester.
(2.75-inch Hydra 70, PA151 Rocket Pallet in the compression tester.)

B. **REPETITIVE SHOCK TEST**. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen was placed on (not fastened to) the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle. Midway into the testing period, the specimen was rotated 90 degrees, and the test continued for the duration. Unless failure occurred, the total time of vibration was three hours. Figure 2 shows an example of the repetitive shock test.

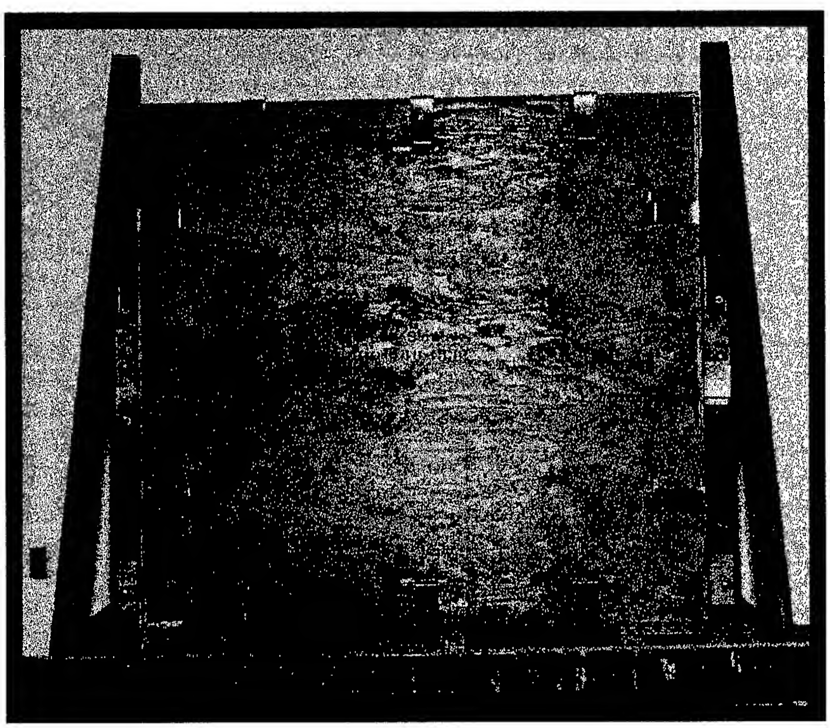

Figure 2. Example of the Repetitive Shock Test.
("Clip-Lok" pallet on the vibration table.)

C. <u>EDGEWISE ROTATIONAL DROP TEST</u>. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test is as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 6 inches high. The height of the beam was increased if necessary to ensure that there was no support for the skids between the ends of the pallet when dropping took place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was then raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conforms to the following tabulation:

GROSS WEIGHT (W/I RANGE LIMITS) (Pounds)	DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (W/I RANGE LIMITS (Inches)	HEIGHT OF DROPS ON EDGES	
150-250	60-66	Level A (Inches)	Level B (Inches)
250-400	66-72	36	27
400-600	72-80	32	24
600-1,000	80-95	28	21
1,000-1,500	95-114	24	18
1,500-2,000	114-144	20	16
2,000-3,000	Above 145 – No Limit	17	14
Above-3,000		15	12
		12	9

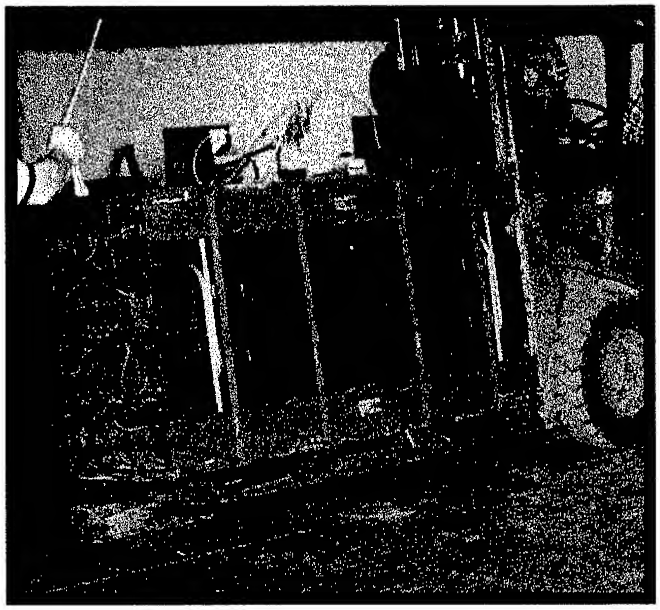

Figure 3. Example of Edgewise Rotational Drop Test (2.75-inch Hydra 70, PA151, Rocket Pallet)

D. <u>INCLINE-IMPACT TEST</u>. This test was conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The specimen was placed on the carriage with the surface or edge to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it were desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber would be attached to the bumper in the desired position before the test. The carriage struck no part of the timber. The position of the container on the carriage and the sequence in which surfaces and edges were subjected to impacts was at the option of the testing activity and depends upon the objective of the tests. This test was to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at the time of the impact was 7 feet-per-second. The test was conducted at ambient

temperature and at extreme temperature conditions. The extreme temperatures were –51 degrees Fahrenheit and +160 degrees Fahrenheit to simulate the temperature extremes that this container could be subjected to aboard ship. Figure 4 shows an example of this test.

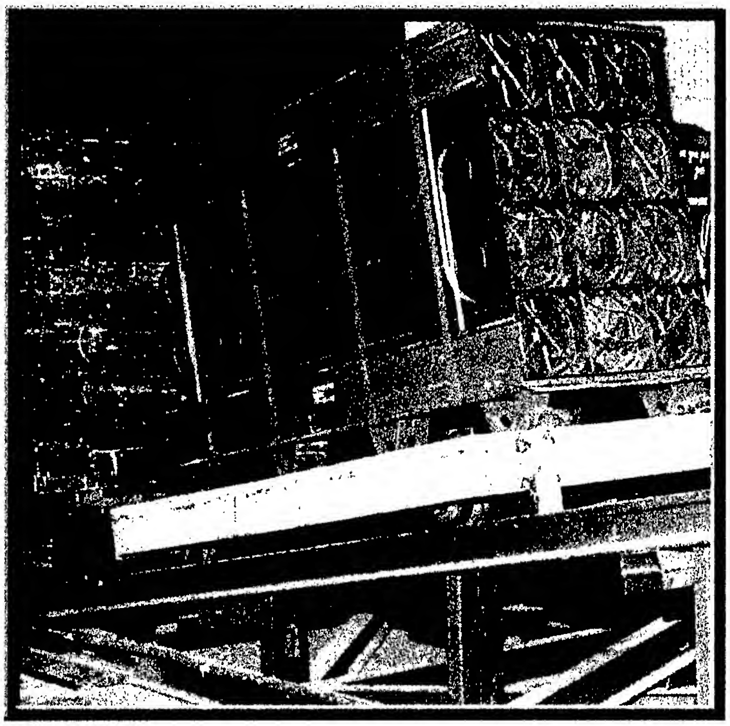

Figure 4. Example of the Incline-Impact Test.
(2.75 Inch, Hydra 70, PA151 Rocket Pallet on incline-impact tester.)

PART 9 - TEST EQUIPMENT

A. COMPRESSION TESTER.

1. Manufacturer:	Ormond Manufacturing
2. Platform:	60- by 60-inches
3. Compression Limit:	50,000 pounds
4. Tension Limit:	50,000 pounds

B. TRANSPORTATION SIMULATOR.

1. Manufacturer:	Gaynes Laboratory
2. Capacity:	6,000-pound pallet
3. Displacement:	1/2-inch amplitude
4. Speed:	50 to 400 RPM
5. Platform:	5- by 8-foot

C. INCLINED PLANE.

1. Manufacturer:	Conbur Incline
2. Type:	Impact Tester
3. Grade:	10 percent incline
4. Length:	12-foot

D. ENVIRONMENTAL CHAMBER.

1. Manufacturer:	Webber Mfg. Inc.
2. Model Number:	F125-75 + M5X
3. Controller:	Micristar
4. Model Number:	828-D00-43-000-120-00

PART 10 - TEST RESULTS

The container was inertly loaded to the specified design weight. Special care was taken to ensure that each container had the proper amount of weight in order to achieve a realistic pallet center of gravity (CG). Once properly prepared, the container pallet was tested using MIL-STD-1660, Design Criteria for Ammunition Unit Loads, requirements.

A. **COMPRESSION TEST**. On 13 April the test pallet was compressed with a load force of 3,675 pounds for 60 minutes at ambient temperature. No damage was noted as a result of this test. On 28 April the test pallet was compressed with a load force of 2,680 pounds for 60 minutes at –51 degrees Fahrenheit. No damage was noted as a result of the compression test, however the strapping could be a concern because of thermal expansion. Before subjecting the pallet to the cold temperature the strapping could be pulled out 5/8" with 20 pounds-force. After subjecting the pallet to the cold temperature the strapping on the pallet could be pulled out 1 –3/4 inches using 10 pounds-force. This is noted and should be noted on the drawing when this container is stacked in a cold environment.

B. **REPETITIVE SHOCK TEST**. The test pallet was vibrated 90 minutes at 207 RPM perpendicular to the pallet skids and 90 minutes at 240 RPM parallel to the pallet skids.

C. **EDGEWISE ROTATIONAL DROP TEST**. The test pallet was edgewise rotationally dropped from a height of 24-inches parallel to the pallet skids and 22-inches perpendicular to the pallet skids. No problems were encountered.

D. **INCLINE-IMPACT TEST**. On 13 April the test pallet was incline-impacted on all four sides with the pallet impacting the stationary wall from a distance of 8 feet at ambient temperature with no problems encountered. On 28 April a single container with serial number 040599-08 was tested as –51 degrees Fahrenheit with 1152 pounds of inert weight placed behind the container to simulate columnar loading of 60 feet. The

container impacted the target cover end first at 7.5 mph with no damage. On 29 April a single container with serial number 041599-26 was tested at +160 degrees Fahrenheit loaded the same as shown above. No damage was noted. It was noted that there was about ¼" difference in slack on the strapping after being subjected to the extreme temperature.

E. **DISSASSEMBLY TEST**. Following completion of MIL-STD-1660 testing, the pallet was disassembled and inspected for damage. No significant damage was noted.